



HAL
open science

Gymnocranius obesus , a new large-eye seabream from the Coral Triangle

Wei-Jen Chen, Ryohei Miki, Philippe Borsa

► **To cite this version:**

Wei-Jen Chen, Ryohei Miki, Philippe Borsa. *Gymnocranius obesus* , a new large-eye seabream from the Coral Triangle. *Comptes Rendus Biologies*, 2017, 340 (11-12), pp.520 - 530. 10.1016/j.crv.2017.08.004 . ird-01665944v1

HAL Id: ird-01665944

<https://ird.hal.science/ird-01665944v1>

Submitted on 17 Dec 2017 (v1), last revised 26 Oct 2018 (v2)

HAL is a multi-disciplinary open access archive for the deposit and dissemination of scientific research documents, whether they are published or not. The documents may come from teaching and research institutions in France or abroad, or from public or private research centers.

L'archive ouverte pluridisciplinaire **HAL**, est destinée au dépôt et à la diffusion de documents scientifiques de niveau recherche, publiés ou non, émanant des établissements d'enseignement et de recherche français ou étrangers, des laboratoires publics ou privés.

To be cited as:

Chen W.-J., Miki R., Borsa P. (2017) *Gymnocranius obesus*, a new large-eye seabream from the Coral Triangle. *Comptes Rendus Biologies* 340, 520-530. , doi: 10.1016/j.crvi.2017.08.004

Taxonomie / Taxinomie

***Gymnocranius obesus*, a new large-eye seabream from the Coral Triangle**

Gymnocranius obesus, un nouveau bossu blanc du Triangle de Corail

Wei-Jen Chen ^a, Ryohei Miki ^b, Philippe Borsa ^{c,*}

^a Institute of Oceanography, National Taiwan University, Taipei, Taiwan

^b Nobeoka Marine Science Station, Field Science Center, University of Miyazaki, Miyazaki, Japan

^c Institut de recherche pour le développement (IRD), Océans department, Marseille, France

* Corresponding author: Philippe Borsa, IRD-UMR 250 "Ecologie marine tropicale des océans Pacifique et Indien", IRD France-sud, 911 avenue Agropolis, 34394 Montpellier cedex, France
Tel. +33 6 46838763. E-mails: philippe.borsa@ird.fr, philippeborsa@gmail.com

ABSTRACT

Two previously recorded new species of the large-eye seabream genus *Gymnocranius* (*Gymnocranius* sp. D and *Gymnocranius* sp. E) remain undescribed. Here we describe *Gymnocranius* sp. E as *Gymnocranius obesus* sp. nov. This new species is morphologically distinct from all other known species under *Gymnocranius* by the following combination of characters: relatively deep body, with ratio of standard length to body depth 2.2-2.4; protruding large eye, with eye diameter about equal to or slightly larger than inter-orbital width; caudal fin moderately forked; no blue spots or wavy blue lines on cheek and snout in adults; fourth transversal dark bar on flank running from 6th spine of dorsal fin to origin of anal fin; anal, caudal and dorsal fins drab with yellowish to yellow margins. *Gymnocranius obesus* sp. nov. is distinct from *G. griseus* with which it has been previously confused by a relatively larger head, scales above lateral line without dark basal patch, and a smaller number of front scales on the dorsal side of head. *Gymnocranius obesus* sp. nov. is genetically distinct from its closest known relative, *Gymnocranius* sp. D by 104 diagnostic nucleotide characters, which translates into 9.6% sequence divergence at the mitochondrial cytochrome *b* gene. *Gymnocranius obesus* sp. nov. reaches a length of at least 295 mm. Its distribution, from the Ryukyu Islands to Bali, including Taiwan and the Flores Sea, mostly coincides with the western half of the Coral Triangle.

Keywords: New species; Indo-West Pacific; *Gymnocranius* sp. D; *Gymnocranius griseus*

RESUME

Deux nouveaux bossus blancs du genre *Gymnocranius*, précédemment signalés comme *Gymnocranius* sp. D et *Gymnocranius* sp. E, restent non décrits. Nous décrivons ici *Gymnocranius* sp. E comme *Gymnocranius obesus* sp. nov. Cette nouvelle espèce est morphologiquement distincte de toutes les autres espèces connues du genre *Gymnocranius* par la combinaison de caractères suivante : corps relativement haut, où le rapport de la longueur standard à la hauteur du corps est 2.2-2.4 ; oeil saillant, large, dont le diamètre est approximativement égal ou légèrement supérieur à la distance inter-orbitaire ; nageoire caudale modérément fourchue ; pas de taches bleues ni de lignes bleues ondulées sur la joue et le museau chez les adultes ; quatrième barre transversale sombre sur le flanc allant de la base du 6ème rayon de la nageoire dorsale à l'origine de la nageoire anale ; bord externe des nageoires anale, caudale et dorsale jaunâtre à jaune. *Gymnocranius obesus* sp. nov. se distingue de *G. griseus* avec lequel il a été précédemment confondu par une tête relativement plus grande, des écailles au-dessus de la ligne latérale sans patch basal sombre, et un plus petit nombre d'écailles frontales sur le dos de la tête. *Gymnocranius obesus* sp. nov. est génétiquement distinct de son plus proche parent connu, *Gymnocranius* sp. D, par 104 caractères nucléotidiques diagnostiques au gène mitochondrial du cytochrome b, ce qui se traduit par une divergence de séquence de 9,6%. *Gymnocranius obesus* sp. nov. atteint au moins 295 mm de longueur. Sa distribution, des îles Ryukyu à Bali en passant par Taïwan et la mer de Flores, coïncide essentiellement avec la moitié ouest du Triangle de Corail.

Mots clés: Nouvelle espèce ; Indo-Pacifique ouest ; *Gymnocranius* sp. D ; *Gymnocranius griseus*

1. Introduction

Large-eye seabreams of the genus *Gymnocranius* Klunzinger 1870 occur in the tropical and warm-temperate coastal waters of the Indo-West Pacific region. They dwell over sandy bottoms at or in the vicinity of coral reefs, at depths ranging from 1 metre to about 80 metres [1-3]. The genus *Gymnocranius*, together with the genera *Gnathodentex* Bleeker 1873, *Wattsia* Chan and Chilvers 1974, and *Monotaxis* [Bennett] 1830 form the Monotaxinae which is one of the two subfamilies of the perciform family Lethrinidae [1]. The genus *Gymnocranius* currently comprises 10 valid species described between 1830 and as recently as 2013 [4]. These are: *G. audleyi* Ogilby 1916 [5], *G. elongatus* Senta 1973 [6], *G. euanus* (Günther 1879) [7], *G. frenatus* Bleeker 1873 [8], *G. grandoculis* (Valenciennes 1830) [9], *G. griseus* (Temminck and Schlegel 1843) [10], *G. microdon* (Bleeker 1851) [11], *G. oblongus* Borsa, Béarez and Chen 2010 [2], *G. satoi* Borsa, Béarez, Paijo and Chen 2013 [3], and *G. superciliosus* Borsa, Béarez, Paijo and Chen 2013 [3]. Twelve other species that have been described since 1830 have been recognized as junior synonyms of the foregoing [4]. In addition, *G. olivaceus* Fourmanoir 1961 [12], is recognized as a junior synonym of *Wattsia mossambica* (Smith 1957) [1, 13]. *Sparus ornatus* Sevastianoff 1805 [14] has lost its precedence to its junior synonym *G. grandoculis* because the species name was not used after 1899 (Article 23.9 of the International Code of Zoological Nomenclature [15]).

Large-eye seabreams are sold at local fish markets throughout the tropical and warm-temperate Indo-West Pacific ([1]; authors' personal observations). Specimens suspected to possibly represent two unknown *Gymnocranius* species were first noticed at the Kedongan fish market in Bali in February 2007 (Supplementary Figs. S1A,B and S3A). Provisional species names *Gymnocranius* sp. D and sp. E were given [3, 16]. These two species were subsequently observed by WJC, along with other *Gymnocranius* species, at several local fish markets in eastern and southern Taiwan and on Penghu Islands in the Taiwan Strait during a biodiversity survey of lethrinid fishes in Taiwanese waters [16]. The two species differed by their patterns of dark bars on the flank and by the colouration of the margin of the caudal fin, which is reddish in *Gymnocranius* sp. D and yellowish in *Gymnocranius* sp. E [16]. Other specimens of these two species were simultaneously collected from the Ryukyu Islands by RM who reached the same conclusions. Two of us (PB, WJC) initially intended to describe *Gymnocranius* sp. D together with *Gymnocranius* sp. E. However, as a paper by RM describing *Gymnocranius* sp. D was already in preparation, all three present co-authors agreed to separately describe the other species. The objective of the present paper is thus to describe *Gymnocranius* sp. E as a new species based on morphological and molecular diagnoses.

2. Materials and methods

2.1. Material examined

Specimens chosen as type material for the new species, *Gymnocranius obesus* sp. nov., were deposited at the Division of Fisheries Science, University of Miyazaki (MUFS) and at the National Taiwan University Museums, Taipei (NTUM) collections. Our specimen Let1006 collected from Fugang fishing port (22°47'30"N 121°11'31"E), Taiwan, 03 October 2013 (Fig. 1), catalogued no. NTUM 12079, was selected as the holotype. Seven other specimens were designated as paratypes: MUFS 25522 from Yaku-shima, Ryukyu islands, Japan, 11 August 2008; MUFS 41271 and MUFS 41272 from Okinawa Island, Japan, 27 October 2012; and NTUM 10766 including four individuals with sample nos. Let998, Let999, Let1004, and Let1005 from Fugang fishing

port, Taiwan, 03 October 2013 (Fig. 1). Additional voucher specimens are listed in Supplementary Table S1 and Supplementary Fig. S1.

Comparative material used for morphological examination included: NTUM 10722 (*G. griseus*; one individual: Let734), Chenggong fishing port, Taiwan; NTUM 10768 (*G. griseus*; six individuals: Let1000, Let1001, Let1007-Let1010) from Fugang fishing port; NTUM 10808 (*G. griseus*; one individual: Let1168) from Fugang fishing port; NTUM 10818 (*Gymnocranius* sp. D: one individual, Let1211) from Penghu Islands; NTUM 10826 (*Gymnocranius* sp. D: one individual, Let1191) from Hengchun town; NTUM 10831 (*Gymnocranius* sp. D: one individual, Let1341) from Macclesfield Bank in the South China Sea (114°48'E 16°10'N); NTUM 10835 (*Gymnocranius* sp. D: two individuals, Let1362, Let1363) from Hengchun town; RMNHN.PISC.D.2248 (*G. griseus*, lectotype [17]) from the Nagasaki region [17]; RMNHN.PISC.1026 (*G. griseus*, paralectotype); and additional voucher specimens listed in Supplementary Figs. S2-S4.

Other type materials examined included ANSP 68291 (*G. orbis*, holotype), MNHN 0000-1317 (*Pentapus curtus*, holotype), MNHN 0000-8811 (*Cantharus grandoculis*, holotype), MNHN 2009-0009 (*G. oblongus*, holotype), MNHN 2009-0010 (*G. superciliosus*, holotype), MNHN 2011-0103 (*G. satoi*, holotype), RMNH 5680 (*Dentex lethrinoides*, holotype, and *Lobotes microprion*, syntypes), SAM 10037 (*D. robinsoni*, holotype), and SMF 3042 (*D. rivulatus*, holotype).

2.2. Measurements on specimens and identification to species

The specimens were photographed shortly after collection to record their fresh colour patterns. Standard length (SL), largest body depth (BD), body depth at origin of first dorsal fin, body depth at origin of first anal fin, and pre-dorsal, pre-pelvic and pre-anal lengths were measured to the nearest millimeter. Head length, snout length, eye diameter (ED), inter-orbital width (IOW) and median ray of caudal fin length (MRC) were measured to the nearest tenth of millimeter using a vernier calliper. All the foregoing measurements followed [1]. Other measurements are listed in Table 1. Identification to species was done according to various complementary sources [1-3, 18] or was assessed against the genetic library of Lethrinidae based in WJC's laboratory.

The relative proportions of eye diameter and body depth of the lectotype of *G. griseus* (RMNHN.PISC.D.2248) were obtained from the sharp photograph reproduced in Supplementary Fig. S2A.

2.3. Genetics

A small piece of muscle was excised from the flank, preserved in 95% ethanol, and stored at -20° C before genomic DNA extraction. Nucleotide sequences of the mitochondrial cytochrome *b* (*cytb*) and/or cytochrome c oxidase I (*COI*) genes from five *G. obesus* sp. nov. specimens including MUFS 25522 from Yaku-shima Island, Japan, MUFS 41271 and MUFS 41272 from Okinawa Island, Japan. NTUM 10766 from eastern Taiwan, and NTUM 12079 (holotype) from eastern Taiwan were generated according to the laboratory protocols and procedures of, respectively, [16] and [19]. The chromatograms were edited and assembled using the CodonCode Aligner v. 6.0.2 software (CodonCode Corporation, Dedham, MA, USA). The sequences were deposited in DDBJ (<http://www.ddbj.nig.ac.jp/>; accession nos. LC213035 to LC213038) and in GenBank (<http://www.ncbi.nlm.nih.gov/>; accession nos. KY593332 to KY593334) as a genetic reference for future DNA-identification and other

research on large-eye seabreams. The cytochrome *b* gene sequences were aligned with homologous sequences from *G. elongatus*, *G. grandoculis*, *G. griseus*, *G. oblongus*, *G. satoi*, *Gymnocranius* sp. D, and *G. obesus* sp. nov. (GenBank accession nos. AF381260, AF381275, AF381259, KU597061, KX357715, KX357714, and KX357713, respectively) published previously [16, 20], and with those of *G. superciliosus* produced by [3]. The nucleotide sequences were compiled and aligned manually with Se-Al v. 2.0 [21] and MEGA6 [22]. The software PAUP* [23] was used to compute pairwise *p* distances, to visualize those nucleotides at the *cytb* locus that are diagnostic of different species, and to determine apomorphic nucleotide sites in *G. obesus* sp. nov. The *COI* gene sequences assigned to the genus *Gymnocranius* that were available from the GenBank and BOLD (www.boldsystems.org) databases were compared against homologous sequences of reference *G. obesus* sp. nov. specimens. This screening was aimed at verifying whether any belonged to *G. obesus* sp. nov., for the purpose of documenting the species' distribution (see next sub-section).

2.4. Distribution

The geographic distribution of *G. obesus* sp. nov. was deduced from four potential sources: (1) WJC and PB's database of large-eye seabream specimens, tissue samples, nucleotide sequences and photographs, comprising a total of 329 individuals from 12 locations in the Indian Ocean (in South Africa, Kenya, Iles Eparses, Mayotte, Reunion, Seychelles, Maldives, Aceh, western Sumatra, and northwestern Australia), 12 locations in the Coral Triangle (in Taiwan, the South China Sea, Malaysia, Vietnam, the Philippines, Indonesia, and West Papua), and nine locations in the western Pacific Ocean (in Japan, Papua New Guinea, New Caledonia, Fiji, the Marshall Islands, and French Polynesia); (2) additional information on its occurrence in the Japanese archipelago, which was presented (as "*Gymnocranius* sp. 1") at the 2016 annual Asian Society of Ichthyologists meeting by RM and Y. Iwatsuki [24]; (3) GenBank; (4) BOLD.

2.5. Notice

The present article in portable document (.pdf) format is a published work in the sense of the International Code of Zoological Nomenclature [25] or Code and hence the new names contained herein are effectively published under the Code. This published work and the nomenclatural acts it contains have been registered in ZooBank (<http://zoobank.org/>), the online registration system for the International Commission on Zoological Nomenclature. The ZooBank life science identifier (LSID) for this publication is urn:lsid:zoobank.org:pub:9CEB9BF1-E635-45F0-AC92-FA7A1A10CAA9. The online version of this work is archived and available from the *Comptes Rendus Biologies* (www.sciencedirect.com/science/journal/aip/16310691) and haL-IRD repository (<http://www.hal.ird.fr/>) websites.

3. Results and Discussion

Species in the genus *Gymnocranius* are all moderately large and of high commercial value [1-3, 10, 26]. Despite this, *G. obesus* sp. nov. has remained unnoticed in the ichthyological literature until recently [3, 16, 24]. A possible explanation for this oversight is its previous confusion with *G. griseus* [27, 28]. *Gymnocranius obesus* sp. nov. has also been confused with juvenile or pre-adult *G. grandoculis* [28].

3.1. Morphological comparison of *G. obesus* sp. nov. with congeneric species

Measurements on *Gymnocranius obesus* sp. nov. specimens are provided in Table 1 and in Supplementary Table S1. Homologous measurements on reference specimens of *G. griseus* and *Gymnocranius* sp. D are provided in Supplementary Tables S2 and S3, respectively. Morphological features including body shape, caudal fin shape, and pigmentation patterns are here compared across 12 *Gymnocranius* species, including all 10 species currently recognized as valid, *G. obesus* sp. nov., and *Gymnocranius* sp. D (Table 3).

Several species in the genus *Gymnocranius*, including *G. frenatus*, *G. grandoculis*, *G. microdon*, *G. oblongus*, *G. satoi* and *G. superciliosus* possess blue lines or dots on the snout and cheek. Scattered blue dots on snout and cheek are also present in some individuals of *G. euanus*, which also has a distinctive head shape (Table 3). The remaining five species, i.e. *G. audleyi*, *G. elongatus*, *G. griseus*, *Gymnocranius* sp. D and *G. obesus* sp. nov. do not possess blue ornamentation on snout and cheek. *Gymnocranius audleyi* has a distinctive parietal scale patch and *G. elongatus* has a distinctive swallow-like tail. The confusion of *G. obesus* sp. nov. with juvenile or pre-adult *G. grandoculis* [28], was possibly due to the fact that the patterns of dark bars on the flank are similar between the two species, with the fourth dark bar running from the base of the sixth or seventh spine of dorsal fin to the origin of anal fin (Table 3). However, the body is more slender in *G. grandoculis* and the colour of the anal fin in adult *G. grandoculis* is different (Table 3). Additional characters are needed for the morphological distinction of *G. obesus* sp. nov. from the remaining two species, namely *G. griseus* and *Gymnocranius* sp. D.

The lectotype of *Dentex* (= *Gymnocranius*) *griseus* (Supplementary Fig. S2A) had a ratio of SL to BD of 2.6; the eye diameter (ED) was 7.9% of SL. As pointed out previously by specialists of the family Lethrinidae [1, 26], the exaggeratedly elongate shape of the lectotype may reflect distortion caused by the preparation of the dried specimen. Measurements on the drawing representing *G. griseus* in C.J. Temminck and H. Schlegel's original description (plate 36 of [10]) were the following: ratio of SL to BD = 2.25; ratio of SL to HL = 3.4; ratio of ED to length of caudal fin's median ray (MRC) = 0.89. Neither the body shape of the presumably distorted lectotype of *G. griseus* nor that of the lithography accompanying the description can be considered as representative of the species. A particular morphological feature enabled us to distinguish *G. obesus* sp. nov. from *G. griseus*: the number of front scales on the top of head. We counted four to six front scales (Fig. 2) in *G. obesus* sp. nov., while nine to eleven were present in *G. griseus*, including the lectotype, which had nine (RM, pers. obs.; Supplementary Fig. S4). Last, *G. obesus* sp. nov. differed from *G. griseus* by the dark-bar patterns on flanks. While the fourth transversal dark bar in *G. obesus* sp. nov. ran from the basis of the sixth spine of the dorsal fin down to the origin of the anal fin, that in *G. griseus*, when visible, ran down from the base of the sixth dorsal spine to the abdomen (Table 3).

Gymnocranius obesus sp. nov. was also characterized by its remarkably large eye. Eye diameter (ED) was about equal to or larger than the IOW (ratio of ED to IOW = 1.0-1.3) and generally found to be larger than the MRC, with a ratio of ED to MRC = 1.0-1.2 (Table 1, Supplementary Table S1) while the eye diameter of both *Gymnocranius* sp. D and *G. griseus* was generally smaller than both the IOW and MRC (Supplementary Tables S2 and S3). Other body proportions did not clearly differ between *G. obesus* sp. nov., *G. griseus*, and *Gymnocranius* sp. D (Table 1; Supplementary Tables S1-S3): the ratio of SL to BD was 2.2-2.4 in *G. obesus* sp. nov., vs. 2.1-2.4 and 2.2-2.6 in *G. griseus* and *Gymnocranius* sp. D, respectively; the ratio of SL to HL was 3.0-3.2 vs. 3.2-3.5 and 3.1-3.3 in *G. griseus* and *Gymnocranius* sp. D, respectively; and the ratio of ED to MRC was 1.0 to 1.2 vs. 0.9-1.1 and 0.8-1.2 in *G. griseus* and *Gymnocranius* sp. D, respectively. The upper lip of *G. obesus* sp. nov. was yellow (Fig. 1; Supplementary Fig. S1); the

upper lip in *G. griseus* was generally drab, with sometimes a yellowish or a reddish hue (Supplementary Fig. S2); the lower edge of the upper lip in *Gymnocranius* sp. D was vermilion red (Supplementary Fig. S3). Three other morphological features distinguished *G. obesus* sp. nov. from *G. griseus*: (1) *G. griseus* had relatively shorter head, with ratio of SL to HL = 3.2-3.5, compared to 2.7-3.2 in *G. obesus* sp. nov.; (2) Unlike *G. obesus* sp. nov., the scales on flank above the lateral line in *G. griseus* had a darker spot giving the appearance of longitudinal rows. *G. obesus* sp. nov. and *Gymnocranius* sp. D roughly had the same deep body shape, but differed by their patterns of dark bars on the flank [16, 24] and by the colouration of the caudal fin, whose margin was reddish in *Gymnocranius* sp. D and yellowish in *G. obesus* sp. nov. [16].

In summary, *G. obesus* sp. nov. is distinct from *G. griseus*, *Gymnocranius* sp. D, and any other known species in the genus *Gymnocranius* by its scale counts and by its body, fin and scale colour patterns.

3.2. Genetic comparison of *G. obesus* sp. nov. with congeneric species

Gymnocranius obesus sp. nov. was differentiated from the seven other congeneric species mentioned in Table 2 by 9.6% to 13.5% nucleotide sequence divergence at the mitochondrial cytochrome *b* gene. In particular, nucleotide sequences confirmed that *G. griseus*, *Gymnocranius* sp. D and *G. obesus* sp. nov. belong to three distinct genetic lineages. From the sample of eight *Gymnocranius* species for which cytochrome-*b* gene sequences were available, the closest relative of *G. obesus* sp. nov. was *Gymnocranius* sp. D (Table 2). The genetic distance (*p*-distance) between the two species was 0.096. One hundred and four diagnostic nucleotide sites were scored between *Gymnocranius* sp. D and *G. obesus* sp. nov. Four single-nucleotide polymorphisms were found within *G. obesus* sp. nov. based on five specimens from Taiwan and Japan. The *p*-distance between *G. obesus* sp. nov. and *G. griseus* was 0.109. The two foregoing values were substantially higher than the genetic distance between *G. satoi* and *G. superciliosus* (*p*-distance = 0.082) or that between *G. grandoculis* and *G. oblongus* (*p*-distance = 0.087) (Table 2). The latter four species being reproductively isolated from one another [29], it is sensible to assume reproductive isolation between *G. griseus*, *Gymnocranius* sp. D, and *G. obesus* sp. nov.

Thus, we can now formally describe *G. obesus* sp. nov. A re-description of *G. griseus* and the formal description (or re-description) of *Gymnocranius* sp. D are pending taxonomic issues that will be addressed separately by RM.

3.3. Need for a comprehensive phylogeny of the Monotaxinae

It is common taxonomic practice to accompany new species descriptions with an identification key, in particular if former keys are obsolete. Existing identification keys in the Monotaxinae [1, 26] are based on morphological characters with no reference to a phylogenetic hypothesis for the sub-family. The key proposed by [1] remains useful to identify most of the currently valid species in the Monotaxinae. The interested reader is able complete it using the information summarized in Table 3. The additional, specific information provided in this paper should further enable the interested reader to easily distinguish *G. obesus* sp. nov. from all other species including, in particular, *G. griseus* and *Gymnocranius* sp. D.

Our position is that identification keys should be based on phylogenetically informative characters and that any revision of a taxon should be well grounded in a robust phylogenetic framework. An elaborate identification key of the of the sub-family Monotaxinae should be proposed at some stage, but not before the potential new species in *Gymnocranius* have been solved out and a comprehensive, robust phylogeny has been produced. A revision of the

Monotaxinae currently is in preparation, which will be based on the phylogeny of all valid species including *G. griseus* once it has been re-described, *G. obesus* sp. nov., *Gymnocranius* sp. D, and four other cryptic lineages in the genera *Gymnocranius* and *Monotaxis* (WJC and PB, unpublished).

4. Taxonomy

Gymnocranius obesus sp. nov. <http://zoobank.org/urn:lsid:zoobank.org:act:83F64FF2-41C9-47E8-B5B9-C284DC8F1AF5> (Table 1; Fig. 1A-H; Fig.2; Supplementary Fig. S1). Previously referred to as *Gymnocranius* sp. E [3,16], *Gymnocranius* sp. 1 [24], *G. griseus* [27,28], and *G. grandoculis* [28].

4.1. Types

Holotype: NTUM 12079 (Fig. 1A). Paratypes: MUFS 25522 (Fig. 1B), MUFS 41271 (Fig. 1C), MUFS 41272 (Fig. 1D), and NTUM 10766 (four individuals; Fig. 1 E-H). Details in sub-section 2.1 and in legend to Fig. 1.

4.2. Description

The new species is described under *Gymnocranius* Klunzinger, 1870 because it has the following general characteristics of the species of this genus ([1]; Table 3): laterally compressed, ovate body; profile of head in front of eye convex, slope of snout relatively steep; adult specimens often develop a bony ridge on nape and a bony shelf above the anterior part of eye; mouth small, posterior part of jaw usually anterior to the level of the anterior edge of eye; each jaw with two or three slender canines at front, conical (molariform in *G. euanus*) teeth on the sides, and a range of numerous villiform teeth behind the front teeth; eye relatively large, a pair of close-set, round nasal openings on each side of snout in front of eyes, usually a thin flap of skin on rear edge of anterior opening; dorsal fin continuous with 10 spines and 10 (occasionally 11) soft rays; anal fin with 3 spines and 10 (occasionally 9) soft rays; pectoral fin rays 14; caudal fin strongly to moderately forked (moderately forked in *G. obesus* sp. nov.), usually with pointed or elongate tips (round in *G. euanus* and *G. satoi*); pored scales on lateral line 47 to 53 (48 in the holotype of *G. obesus* sp. nov.; 47 to 49 in paratypes and other voucher specimens); rear part of cheek with three to five transverse scale rows (four in in *Gymnocranius obesus* sp. nov.); remainder of cheek, preorbital, snout, and interorbital region scaleless; inner surface of pectoral fin base scaleless. Their body colour is generally silvery; cheek region below eye often marked with either a dark bar (sometimes faint); fins clear to yellow or reddish (yellowish in *Gymnocranius obesus* sp. nov.). Freshly caught specimens, especially juveniles or small adults, often show a pattern of five to eight transversal dark bars [1].

Gymnocranius obesus sp. nov. specimens possess the following diagnostic combination of characters: body deep, 2.2-2.4 times in standard length (2.25 in holotype), apparently invariable across a range of sizes (Table 1), and plumpy (hence the species epithet); lower edge of eye slightly above a line from tip of snout to middle of caudal fin; eyes protruding and large, the eye diameter (ED) reaching 37-40% of head length (37% in holotype), usually close to or larger than inter-orbital width (IOW) with an ED/IOW ratio of 0.97-1.27 (1.00 in holotype) (Table 1); caudal fin moderately forked, the median rays nearly equal to or slightly shorter than ED; a row of four to six front scales on the dorsal side of head (four in holotype) (Fig. 2); body sides with five to eight transversal dark bars often visible even in adults (Fig. 1; Supplementary Fig. S1),

the fourth one running from the base of the sixth or seventh spine of dorsal fin to the origin of anal fin (Fig. 1; Supplementary Fig. S1); anal, caudal and dorsal fins drab with yellowish to yellow margins, sometimes diffuse mottling or spotting on dorsal, pelvic, anal, and caudal fins (Fig. 1; Supplementary Fig. S1); no visible blue lines or spots on snout and cheek below eye in adults (SL >270 mm) (Fig. 1; Supplementary Fig. S1); upper lip yellow (Fig. 1; Supplementary Fig. S1).

The nucleotide sequence of the *COI* gene of the holotype of *G. obesus* sp. nov. (GenBank KY593332) was: 5'-CTCTATTTAGTATTTCGGTG CATGAGCTGGGATAGTAGGAACCGCCCTAAGCCTTCTCATCCGAGCGGAACCTTAGTCAACCAGGCGCTCTCCTGGGGGACGACCAGATTTACAATGTAATCGTTACAGCACACGCCCTTCGTAATGATTTTCTTTATAGTAATACCAATTATGATCGGAGGCTTTGGAAATGACTTATCCCCCTAATGATCGGGGCCCTGACATGGCATTCCCTCGAATGAACAACATGAGCTTTTACTTCTCCCCCTTCCTTCTACTGCTCCTAGCCTCCTCAGGCATTGAAGCCGGAGCAGGTACCGGATGAACAGTCTACCCC CCACTAGCTGGTAACCTTGCTCACGCTGGAGCATCTGTTGACTTAACCATTTTCTCCCTCCACCTAGCTGGCATCTCCTCGATCCTGGGGGCTATTAATT TATTACAACCATCATCAATATAAAACCCCCGCCATCTCTCAATACCAGACCCCTCTTTTCGTTTGAGCAGTCCTAATCACTGCTGTCCTTCTCCTCCTTTCGCTGCCAGTCTTAGCCGCAGGCATCACAATACTCCTTACGGACCGAAACTTAAACACAACCTTTCTTTGACCCAGCAGGCGGGGGGGACCCGATTCTT-3'.

4.3. Diagnosis

Gymnocranius obesus sp. nov. differs from its morphologically close congeners *G. griseus* and *Gymnocranius* sp. D by the number of front scales on the top of head, and by the dark-bar patterns on flanks. While the fourth transversal dark bar in *G. obesus* sp. nov. runs from the basis of the sixth spine of the dorsal fin down to the origin of the anal fin, that in *G. griseus*, when visible, runs down from the base of the sixth dorsal spine to the abdomen (Table 3). That in *Gymnocranius* sp. D descends from sixth dorsal spine to the extremity of abdomen, before anus (Table 3).

Along the cytochrome *b* gene, the following apomorphic sites have nucleotides shared by all five specimens of *G. obesus* sp. nov. examined so far, that are not present in *G. elongatus*, *G. euanus*, *G. grandoculis*, *G. griseus*, *G. oblongus*, *G. satoi*, *G. superciliosus* and *Gymnocranius* sp. D: nos. 61, 108, 117, 135, 153, 165, 300, 303, 318, 375, 501, 564, 627, 630, 684, 756, 765, 816, 967, 972, and 1032. These nucleotide sites can be used for the diagnosis of *G. obesus* sp. nov. relative to *G. griseus* and *Gymnocranius* sp. D.

4.4. Habitat and distribution

The type locality is Fugang on the eastern coast of Taiwan. We recorded *G. obesus* sp. nov. from fish landing places in Bali, the Flores Sea, the Ryukyu Islands and Taiwan (Fig. 3). The species was not found in the Coral Sea despite substantial sampling effort targeting Lethrinidae [2, 3, 29]. All records south of the Ryukyu Islands were within the western half of the Coral Triangle as defined by [30]. The single specimen sampled from the Flores Sea was caught by handline together with other lethrinids including *Lethrinus erythropterus*, *L. rubrioperculatus* and *L. semicinctus* which typically inhabit the first tens of metres on the reef slope and adjacent flat areas [1]. We compared eighty-eight nucleotide sequences at the *COI* locus referring to the

genus *Gymnocranius* available from the GenBank and BOLD public databases, to the *COI* gene sequence of the holotype of *G. obesus* sp. nov. The most closely related sequence (GenBank no. JF493563, labelled *G. grandoculis*) diverged by 7.3% nucleotide difference from it. Thus, at the time of writing (January 2017), there was no evidence of the presence of *G. obesus* sp. nov. in these two *COI*-gene sequence databases.

4.5. Etymology

Epithet *obesus* is the latin translation of obese, a reference to the deep and relatively thick body shape of the specimens of this species. We propose the *obese large-eye seabream* as vernacular name for *G. obesus* sp. nov.

4.6. Remarks

The type specimens of *Lobotes microprion* Bleeker 1851 [31] and *Gymnocranius orbis* Fowler 1938 [32], both with deep body shape, exhibit patterns of dark bars on the flank that have been reported to fit those of *G. griseus* [1]. *Lobotes microprion* has also been listed by [26] as a possible synonym of *Dentex robinsoni* Gilchrist and Thompson 1909 [33], now synonymized with *G. grandoculis* [1]. Another species with oblong to deep body shape is *Pentapus curtus* Guichenot 1863 [34] also considered to be a junior synonym of *G. grandoculis* [1] (but see [2, 26]). *Dentex lethrinoides* Bleeker 1850 [35] from Java and *D. rivulatus* Rüppell 1838 [36] are also considered to be junior synonyms of *G. grandoculis* [1].

We found that the dark-bar patterns of the syntypes of *L. microprion* (RMNH 5680), albeit faint, and those of *G. orbis* as represented in drawing [32] look more alike those of *G. frenatus* than *G. griseus* [24]. Further, the two syntypes of *L. microprion* have a row of at least eight front scales on the dorsal side of head and the holotype of *G. orbis* has a row of 11 (Supplementary Fig. S5). *Gymnocranius obesus* sp. nov. thus can be easily distinguished from the foregoing two species. From pictures of the holotype of *Dentex robinsoni* Gilchrist and Thompson 1909 (SAM 10037), we were able to count at least 8 scales in the row of front scales on the dorsal side of the head (Supplementary Fig. S5). Similarly, we counted more than 7 front scales on the holotype of *P. curtus* (Supplementary Fig. S5). We also counted 8 scales in the row of front scales on the dorsal side of the head of the holotype of *D. lethrinoides* (Supplementary Fig. S5). Last, we confirm the synonymy of *D. rivulatus* Rüppell with *G. grandoculis*. Therefore, we can confidently exclude that *G. obesus* sp. nov. is synonymous with *D. lethrinoides*, *D. rivulatus*, *D. robinsoni*, *G. orbis*, *L. microprion*, or *P. curtus*.

Disclosure of interest

We have no conflicts of interest concerning this article, financial or otherwise, that could have influenced its content.

Appendix A. Supplementary data

Supplementary data associated with this article can be found, in the online version, at <http://dx.doi.org/10.1016/j.crv.2017.xx.xxx>.

Acknowledgments

This paper is a contribution of the joint IRD / NTU project on the phylogeography and systematics of emperors and large-eye seabreams, started in 2007. We express our sincere thanks to H. Motomura, T. Yoshida, K. Tashiro, Y. Fukui and H. Hata (KAUM), Z. Gabsi (MNHN), K. Koeda (NMMB), and R. de Ruiter and M.J.P. van Oijen (RMNH) for facilitating RM's visits to collections. We thank Y. Sakurai (Okinawa, Japan), Mr Jhuo (Fugang fishing port), and H.-C. Ho (NMMB) for collecting and supplying some of the specimens. We thank G.R. Allen, P. Béarez, K.E. Carpenter, A. Collet, N. Hubert, J.-L. Justine, D. Ponton, M.J.P. van Oijen and R.D. Ward for stimulating discussions in the course of our Lethrinid project. We also thank two anonymous reviewers for insightful comments that greatly helped improve our paper. We acknowledge the special contribution of F. Giancarlo and S. Bari (Proyek BioKor, Indonesia and West Papua). We thank M. Bougaardt and A. Bosman from the South African Museum, Cape Town and M.S. Pérez from the Academy of Natural Sciences of Drexel University, Philadelphia for providing photographs of *Dentex robinsoni* and *Gymnocranius orbis*. Issues of the *Zoologische Mededeelingen* were consulted from the Naturalis repository website (<http://www.repository.naturalis.nl/>). C.J. Temminck and H. Schlegel's *Fauna Japonica* was consulted from the Kyoto University Library website (<http://kuline.kulib.kyoto-u.ac.jp/>). Other 19th-century and early 20th-century books and articles were consulted from the Biodiversity Heritage Library website (<http://www.biodiversitylibrary.org>). Supported by a Sasakawa scientific research grant from the Japan Science Society (no. 27-506 to RM), by IRD-UMR 250, by the French Ministère des affaires étrangères and by research grants from the Ministry of Science and Technology, Taiwan (MOST 101-2611-M-002-016-MY3 and MOST 104- 2611-M-002-002-MY3 to WJC). Designed the study: PB, WJC, RM; contributed samples: PB, WJC, RM; contributed molecular and morphological data: WJC, RM; analyzed and interpreted the data: PB, WJC, RM; wrote the paper: PB, WJC. All co-authors read, edited, and approved the final version of the manuscript.

References

- [1] K.E. Carpenter, G.R. Allen, FAO species catalogue, vol. 9, Emperor fishes and large-eye breams of the world (family Lethrinidae), An annotated and illustrated catalogue of lethrinid species known to date, FAO Species Synopsis 125, 1989, 118 p.
- [2] P. Borsa, P. Béarez, W.-J. Chen, *Gymnocranius oblongus* (Teleostei: Lethrinidae), a new large-eye bream species from New Caledonia, C. R. Biol. 333 (2010) 241–247. doi: 10.1016/j.crv.2009.12.015
- [3] P. Borsa, P. Béarez, S. Paijo, W.-J. Chen, *Gymnocranius superciliosus* and *Gymnocranius satoi*, two new large-eye breams (Sparoidea: Lethrinidae) from the Coral Sea and adjacent regions, C. R. Biol. 336 (2013) 233–240. doi: 10.1016/j.crv.2013.06.003
- [4] W.N. Eschmeyer, R. Fricke, R. van der Laan (eds.), Catalog of fishes: genera, species, references (<http://researcharchive.calacademy.org/research/ichthyology/catalog/fishcatmain.asp>), 2017 [electronic version accessed 31 May 2017].
- [5] J.D. Ogilby, Edible fishes of Queensland. Parts IV through IX, Mem. Queensland Mus. 5 (1916) 127–177, pls. 14–23.
- [6] T. Senta, A new sparoid fish, *Gymnocranius elongatus* from the southern South China Sea, Japn. J. Ichthyol. 20 (1973) 135-144.
- [7] A. Günther, Notice of two new species of fishes from the south seas (*Diagramma giganteum*, *Sphaerodon euanus*), Ann. Mag. Nat. Hist. 5 (1879) 136-137.

- [8] P. Bleeker, Mededeelingen omtrent eene herziening der Indisch-archipelagische soorten van *Epinephelus*, *Lutjanus*, *Dentex* en verwante geslachten, Verslag. Mededeel. Koninkl. Akad. Wetenschapp. Afd. Natuurk. Ser. 2 7 (1873) 40–46.
- [9] A. Valenciennes, Livre sixième, partie I, Des Sparoïdes, in G. Cuvier, A. Valenciennes (eds.), Histoire naturelle des poissons, tome sixième, F.G. Levrault, Paris, 1830, pp. 1-380, pls. 141-163.
- [10] C.J. Temminck, H. Schlegel, Pisces, In P.F. von Siebold, Fauna Japonica, sive descriptio animalium quae in itinere per Japoniam suscepto annis 1823-30 collegit, etc., Lugduni, Batavorum, 1842-1950, 323 p., 160 pls.
- [11] P. Bleeker, Nieuwebijdrage tot de kennis der ichthyologische fauna van Celebes, Nat. Tijdschr. Ned.-Indië 2 (1851) 209–224.
- [12] P. Fourmanoir, Liste complémentaire des poissons du Canal du Mozambique, Mém. Inst. Sci. Madagascar Sér. F Océanogr. 4 (1961) 83-107.
- [13] J.L.B. Smith, Deep-line fishing in northern Mozambique, with the description of a new pentapodid fish, Ann. Mag. Nat. Hist. 10 (1957) 121-124, pl. 1.
- [14] A. Sevestianoff, Description du *Sparus ornatus*, nouvelle espèce de poisson thoracique, Nova Acta Acad. Scient. Imperialis Petropolit. 14 (1805) 521-526, pl. 10.
- [15] International Commission on Zoological Nomenclature, International code of zoological nomenclature, 4th edn, International Trust for Zoological Nomenclature, London, 1999, 306 p.
- [16] W.-J. Chen, H.-C. Ho, P. Borsa, Taiwanese records of oblong large-eye seabream *Gymnocranius oblongus* (Teleostei: Lethrinidae) and other rare or undetermined large-eye seabreams, Front. Mar. Sci. 3 (2016) 107.doi: 10.3389/fmars.2016.00107
- [17] M. Boeseman, Revision of the fishes collected by Bürger and von Siebold in Japan, Zool. Meded. 28 (1947) 1–242.
- [18] T. Nakabo (ed.), Fishes of Japan with pictorial keys to the species, 3rd edn., Tokai University Press, Tokyo, 2013, 2428 p.
- [19] R.D. Ward, T.S. Zemlak, B.H. Innes, P.R. Last, P.D.N. Hebert, DNA barcoding Australia's fish species, Phil. Trans. R. Soc. B 360 (2005) 1847-1857.
- [20] A. Lo Galbo, K.E. Carpenter, D.L. Reed, Evolution of trophic types in emperor snappers (*Lethrinus*, Lethrinidae, Percoidae) based on cytochrome *b* gene sequence variation, J. Mol. Evol. 54 (2002) 754-762.
- [21] A. Rambaut, Se-Al: Sequence alignment editor ver. 2.0, program distributed by the author, Department of Zoology, University of Oxford, Oxford. <<http://tree.bio.ed.ac.uk/software/seal/>>, 1996.
- [22] K. Tamura, G. Stecher, D. Peterson, A. Filipski, S. Kumar, MEGA6: Molecular Evolutionary Genetics Analysis version 6.0, Mol. Biol. Evol. 30 (2013) 2725–2729.
- [23] D.L. Swofford, PAUP*, Phylogenetic analysis using parsimony (*and other methods), Version 4, Sinauer Associates, Sunderland MA, 2002.
- [24] Anonymous (ed.), Conference program and abstracts, 2016 annual meeting of the Ichthyological Society of Taiwan and the Asian Society of Ichthyologists, Asian Society of Ichthyologists, Taipei, 2016, 198 p.
- [25] International Commission on Zoological Nomenclature, Amendment of Articles 8, 9, 10, 21 and 78 of the International Code of Zoological Nomenclature to expand and refine methods of publication, Bull. Zool. Nomencl. 69 (2012) 161-169.
- [26] T. Sato, A systematic review of the sparoid fishes of the subfamily Monotaxinae, In T. Uyeno, R. Arai, T. Taniuchi, K. Matsuura, (eds.), Indo-Pacific fish biology: proceedings of the

- second international conference on Indo-Pacific fishes, Ichthyological Society of Japan, Tokyo, 1986, pp. 602-612.
- [27] W.-C. Chiang, P.-L. Lin, W.-Y. Chen, D.-C. Liu (eds.), Marine fishes in eastern Taiwan, FRI special publication no. 18, Taiwan Fisheries Research Institute, Keelung, 2014, 318 p.
- [28] K.-T. Shao, The fish database of Taiwan, WWW Web electronic publication (<http://fishdb.sinica.edu.tw>), 2016, accessed 30 January 2016.
- [29] P. Borsa, A. Collet, L. Carassou, D. Ponton, W.-J. Chen, Multiple nuclear and mitochondrial genotyping identifies emperors and large-eye breams (Teleostei: Lethrinidae) from New Caledonia and reveals new large-eye bream species, *Biochem. Syst. Ecol.* 38 (2010) 370-389.
- [30] J.E.N. Veron, L.M. Devantier, E. Turak, A.L. Green, S. Kininmonth, M. Stafford-Smith, N. Peterson, Delineating the Coral Triangle, *Galaxea* 11 (2009) 91-100.
- [31] P. Bleeker, Nieuwebijdrage tot de kennis der Percoïdei, Scleroparei, Sciaenoïdei, Maenoïdei, Chaetodontoïdei en Sombreoïdei van den Soenda-Molukschen archipel, *Nat. Tijdschr. Ned.-Indië* 2 (1851) 163-179.
- [32] H.W. Fowler, Studies of Hong Kong fishes – No. 3, *Hong Kong Natur.* 6 Suppl. (1938) 1-52.
- [33] J.D.F. Gilchrist, W.W. Thompson, Descriptions of fishes from the coast of Natal (part II), *Ann. South Afr. Mus.* 6 (1909) 213-279.
- [34] A. Guichenot, Faune ichthyologique, in: L. Maillard, Notes sur l'île de la Réunion (Bourbon), Deuxième partie, Annexe C, Dentu, Paris, 1863, C1-C32.
- [35] P. Bleeker, Bijdrage tot de kennis der Sparoïden van den Soenda-Molukschen Archipel, *Verhandel. Batav. Genootsch. Kunst. Wetenschappen* 23 (1850) 1-16.
- [36] E. Rüppell, Neue Wirbelthiere zu der Fauna von Abyssinien gehörig, Fische des rothen Meeres, Siegmund Schmerber, Frankfurt am Mein, 1838, ii+148 pp., 33 pl.

Table 1. Measurements on the type material of *Gymnocranius obesus* sp. nov. Sample number in brackets. Homologous measurements on additional voucher specimens are provided as Supplementary Table S1. *MUFS* Miyazaki University Fisheries Science; *NTUM* National Taiwan University Museums, Taipei; *AF* anal fin; *BD* largest body depth; *CF* caudal fin; *DF* dorsal fin; *SL* standard length

| Measurement | Specimen no. | | | | | | | |
|--|-------------------------------------|------------------------|------------------------|------------------------|------------------------------------|------------------------------------|-------------------------------------|-------------------------------------|
| | NTUM 12079 (Let1006) holotype | MUFS 25522 paratype | MUFS 41271 paratype | MUFS 41272 paratype | NTUM 10766 (Let998) paratype | NTUM 10766 (Let999) paratype | NTUM 10766 (Let1004) paratype | NTUM 10766 (Let1005) paratype |
| SL (mm) | 270 | 295 | 209 | 244 | 195 | 220 | 182 | 239 |
| Body depth (BD) (mm) | 120 | 132 | 91 | 108 | 87 | 98 | 78 | 106 |
| BD at origin of DF (mm) | 119 | 132 | 89 | 105 | 86 | 97 | 77 | 105 |
| BD at anal-fin origin (mm) | 108 | 120 | 85 | 100 | 81 | 95 | 74 | 95 |
| Head length (HL) (mm) | 87.5 | 104.0 | 76.6 | 87.1 | 61.6 | 72.0 | 61.5 | 78.8 |
| Snout length (mm) | 37.7 | 43.3 | 32.3 | 36.3 | 20.0 | 25.0 | 21.7 | 30.0 |
| Eye diameter (ED) (mm) | 32.1 | 33.4 | 24.9 | 28.1 | 23.7 | 26.4 | 23.8 | 31.5 |
| Inter-orbital width (IOW) (mm) | 32.0 | 36.9 | 24.1 | 28.8 | 23.1 | 27.2 | 20.0 | 28.5 |
| Predorsal length (mm) | 101 | 131 | 93 | 109 | 72 | 83 | 67 | 92 |
| Prepelvic length (mm) | 93 | 122 | 88 | 100 | 66 | 75 | 57 | 86 |
| Preanal length (mm) | 168 | 193 | 137 | 159 | 117 | 133 | 107 | 144 |
| Length of median ray of CF (MRC) (mm) | 31.5 | 35.4 | 26.4 | 29.8 | 24.8 | 24.8 | 21.7 | 26.7 |
| DF spines, rays | X, 10 | X, 10 | X, 10 | X, 10 | X, 10 | X, 10 | X, 10 | X, 10 |
| AF spines, rays | III, 10 | III, 10 | III, 10 | III, 10 | III, 10 | III, 10 | III, 10 | III, 10 |
| Pored scales on lateral line | 48 | 47 | 48 | 48 | 49 | 47 | 48 | 48 |
| Ratio of SL to BD | 2.25 | 2.23 | 2.30 | 2.25 | 2.25 | 2.24 | 2.32 | 2.26 |
| Ratio of SL to BDd | 2.27 | 2.23 | 2.34 | 2.33 | 2.28 | 2.27 | 2.36 | 2.29 |
| Ratio of SL to HL | 3.09 | 2.83 | 2.73 | 2.80 | 3.17 | 3.06 | 2.96 | 3.03 |
| Ratio of ED to SL | 0.12 | 0.14 | 0.15 | 0.14 | 0.12 | 0.12 | 0.13 | 0.13 |
| Ratio of ED to HL | 0.37 | 0.39 | 0.40 | 0.39 | 0.38 | 0.37 | 0.39 | 0.40 |
| Ratio of ED to IOW | 1.00 | 1.10 | 1.27 | 1.18 | 1.03 | 0.97 | 1.19 | 1.11 |
| Ratio of ED to MRC | 1.02 | 1.15 | 1.16 | 1.14 | 0.96 | 1.06 | 1.10 | 1.18 |

Table 2. Matrix of pairwise genetic distances (p -distance) at the cytochrome b locus, deduced from the nucleotide sequences sampled in 8 species of the genus *Gymnocranius*.

| Sample | | | | Sample | | | | | | | | | |
|--------|---------------------------|----------|------------|--------|-------|-------|-------|-------|-------|-------|-------|-------|----|
| No. | Species | GenBank | Reference | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 |
| 1 | <i>G. elongatus</i> | AF381260 | [20] | - | | | | | | | | | |
| 2 | <i>G. grandoculis</i> | AF381275 | [20] | 0.158 | - | | | | | | | | |
| 3 | <i>G. griseus</i> | AF381259 | [20] | 0.137 | 0.091 | - | | | | | | | |
| 4 | <i>G. obesus</i> sp. nov. | KX357713 | [16] | 0.135 | 0.125 | 0.109 | - | | | | | | |
| 5 | <i>G. obesus</i> sp. nov. | KY593333 | this study | 0.134 | 0.126 | 0.109 | 0.001 | - | | | | | |
| 6 | <i>G. obesus</i> sp. nov. | KY593334 | this study | 0.135 | 0.125 | 0.109 | 0.000 | 0.001 | - | | | | |
| 7 | <i>G. oblongus</i> | KU597058 | [3] | 0.141 | 0.087 | 0.101 | 0.121 | 0.122 | 0.121 | - | | | |
| 8 | <i>G. satoi</i> | KX357715 | [16] | 0.143 | 0.082 | 0.087 | 0.119 | 0.119 | 0.119 | 0.100 | - | | |
| 9 | <i>G. superciliosus</i> | - | [3] | 0.146 | 0.089 | 0.082 | 0.120 | 0.119 | 0.120 | 0.100 | 0.082 | - | |
| 10 | <i>Gymnocranius</i> sp. D | KX357714 | [16] | 0.140 | 0.124 | 0.107 | 0.096 | 0.096 | 0.096 | 0.125 | 0.119 | 0.112 | - |

Table 3. Summary of remarkable morphological features across species in the genus *Gymnocranius*. Compiled from [1-3, 16, 26] and present work. *AF* anal fin; *BD* body depth at origin of first dorsal fin (*DF*); *CF* caudal fin; *PF* pectoral fin; *SL* standard length

| Species | Body shape | | Head | Shape of CF | Pigmentation patterns | | |
|---------------------------|--|---------|--|--|--|---|---|
| | General | BD / SL | | | Head | Head | Flank |
| <i>G. audleyi</i> | High-bodied to oblong | 2.2-2.4 | Snout profile relatively steep | Moderately forked | Parietal scale patch blackish surrounded by brilliant white margin | With scattered brown flecks | Uniformly clear to slightly yellowish |
| <i>G. elongatus</i> | High-bodied to oblong | 2.2-2.4 | Snout somewhat pointed | Strongly forked | No blue ornamentation on snout or cheek | Fourth transversal dark bar running from 6 th spine of DF to anterior portion of AF | Clear to yellow -orange; CF margin and tips often deep red |
| <i>G. euanus</i> | High-bodied to oblong | 2.4-2.5 | Sloping steeply | Moderately forked, inner edge of fork slightly convex, with blunt tips | Scattered blue dots on snout and cheek in some individuals | Scattered blackish scales mainly on anterior half of body | AF, CF, DF, PF clear to reddish |
| <i>G. frenatus</i> | High-bodied to oblong; dorsal side convex, ventral side horizontal | 2.3-2.4 | Dorsal profile sloping steeply, | Moderately forked, inner edge of fork straight, with pointed tips | Obliquely ascending blue bands on snout and cheek | 5-7 narrow, irregular dark bars | Uniformly clear |
| <i>G. grandoculis</i> | High-bodied to oblong | 2.4-2.5 | Forehead profile moderately steep | Moderately forked with subtle middle notch | Series of narrow undulating, longitudinal lines on cheek and side of snout | Overall silvery with thin brown scale margins. In juveniles, fourth transversal dark bar running from 6 th spine of DF to origin of AF | AF, DF, PF clear to yellow orange; CF frequently dusky grey-brown |
| <i>G. griseus</i> | High-bodied to oblong | 1.9-2.3 | Dorsal and ventral profile of head evenly convex | Moderately forked | No blue ornamentation on snout or cheek | Third transversal dark bar from 1 st dorsal spine to lateral line; 4 th transversal dark bar from 6 th dorsal spine to abdomen | Fins mainly clear to yellowish |
| <i>G. microdon</i> | Oblong | 2.5-3.0 | Forehead prominent | Forked with pointed tips | Blue dots or dashes on cheek | Silvery in adults | AF, DF, PF clear to yellow or reddish. CFs sometimes dusky brown |
| <i>G. obesus</i> sp. nov. | High-bodied to oblong | 2.2-2.4 | Protruding, large eye | Moderately forked | No blue ornamentation on snout or cheek | Fourth transversal dark bar running from 6 th spine of DF to origin of AF | AF, CF, DF drab with yellowish to yellow margins |
| <i>G. oblongus</i> | Fusiform | 2.6-2.8 | Forehead prominent | Elongate, tips rounded in adults | Sub-horizontal wavy blue lines or dashes on snout and cheek | Fifth transversal dark bar forward-descending | DF, PF, AF and CF drab, brownish or yellowish with reddish to vermilion edges |
| <i>G. satoi</i> | High-bodied to oblong | 2.4-2.5 | Forehead bumpy | Shallowly forked, lobes convex inside and their extremities rounded | Blue speckles against bronze background on snout and cheeks | Silvery | AF, CF, DF, PF reddish to bright vermilion red |
| <i>G. superciliosus</i> | Oblong to elongate | 2.7-3.1 | Forehead prominent | Moderately forked with a subtle middle notch, its lobes slightly convex inside | Snout and cheek with blue speckles | Silvery | AF, CF, DF, PF reddish to red |
| <i>Gymnocranius</i> sp. D | High-bodied to oblong, symmetric dorso-ventrally | 2.2-2.5 | Eye large | Moderately forked with a subtle middle notch | No blue ornamentation on snout or cheek | Fourth transversal dark bar descending from 6 th spine of DF to anterior to anus | AF, CF, DF drab with orange to vermilion red edge |

Captions to figures

Fig. 1. Type series of *Gymnocranius obesus* sp. nov. **A.** Specimen NTUM 12079 (sample Let1006), holotype, standard length (SL) 270 mm, collected 03 October 2013 from off Fugang, Taitung, Taiwan (photographed by WJC). **B.** Specimen MUFS 25522, paratype, SL 295 mm, from off Anbo, Yaku-shima Island, Kagoshima prefecture, Japan (30°19'N, 130°39'E), 11 August 2008 (photographed by the MUFS fish team). **C.** Specimen MUFS 41271, paratype, SL 209 mm, purchased at Tomari-Fish Market (26°14'N, 127°41'E), Okinawa Island, Japan, 27 October 2012 (photographed by RM). **D.** Specimen MUFS 41272, paratype, SL 244 mm, purchased at the same place and same date (photographed by RM). **E.** Specimen NTUM 10766 (Let998), paratype, SL195mm, from Fugang fishing port, Taiwan, 03 October 2013 (photographed by WJC). **F.** Specimen NTUM 10766 (Let999), paratype, SL220mm, from Fugang fishing port, Taiwan, 03 October 2013 (photographed by WJC). **G.** Specimen NTUM 10766 (Let1004), paratype, SL192mm, from Fugang fishing port, Taiwan, 03 October 2013 (photographed by WJC). **H.** Specimen NTUM 10766 (Let1005), paratype, SL239 mm, from Fugang fishing port, Taiwan, 03 October 2013 (photographed by WJC).

Fig. 2. *Gymnocranius obesus* sp. nov. Dorsal view of head of specimen no. MUFS 41272 (paratype) with front row of scales highlighted in white (photographed by RM).

Fig. 3. Map of Southeast Asia and northern Melanesia showing the occurrence points of the material examined for the present study (see Table 1, Fig. 1, and Supplementary Material) or reported previously [16], including: *Gymnocranius griseus* (squares), *G. obesus* sp. nov. (triangles) and *Gymnocranius* sp. D (circles). Crosses (+) indicate the type localities of *G. griseus* (Nagasaki, Japan) and *G. obesus* sp. nov. (Fugang, Taiwan).

Figure 1



Figure 2

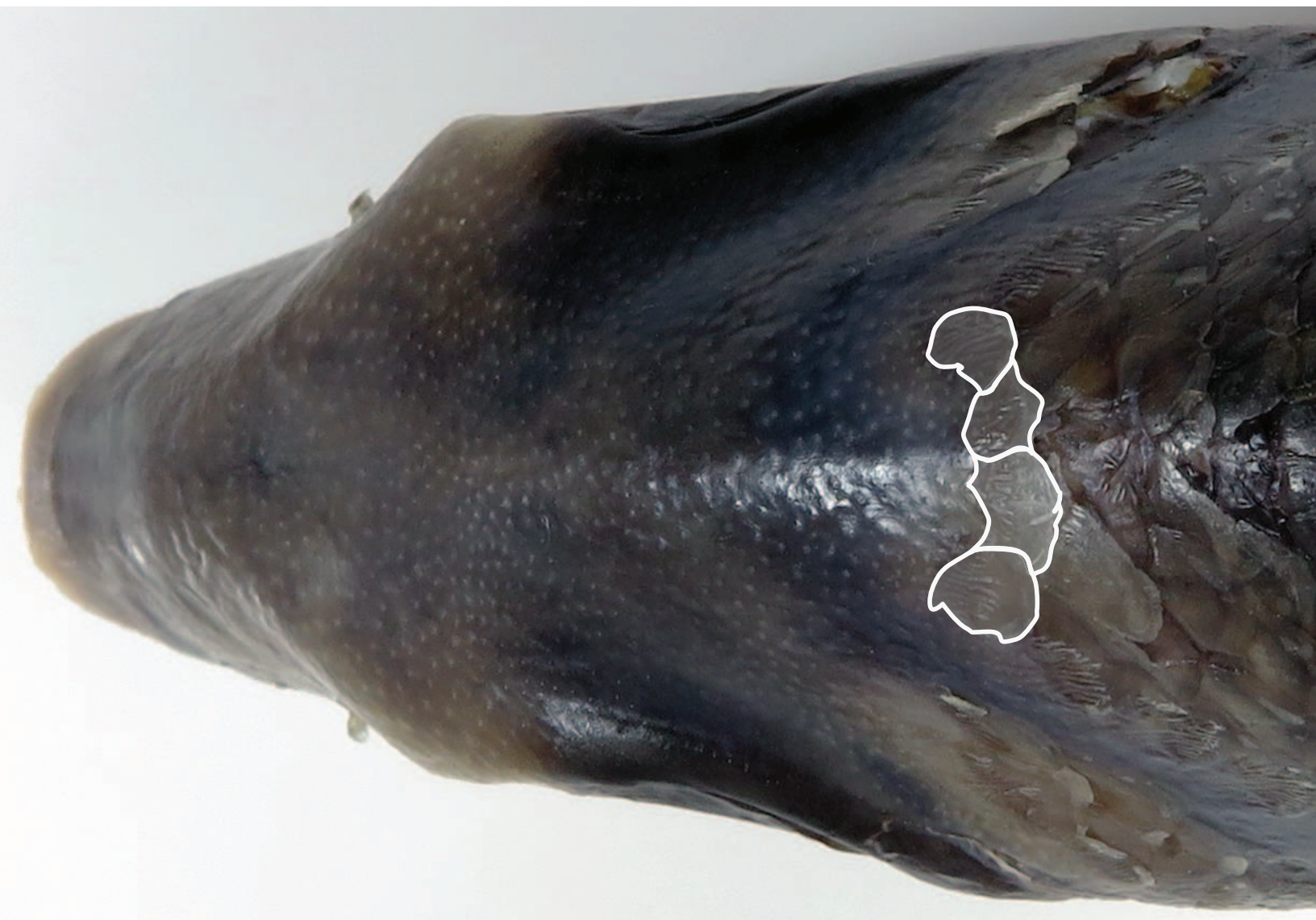
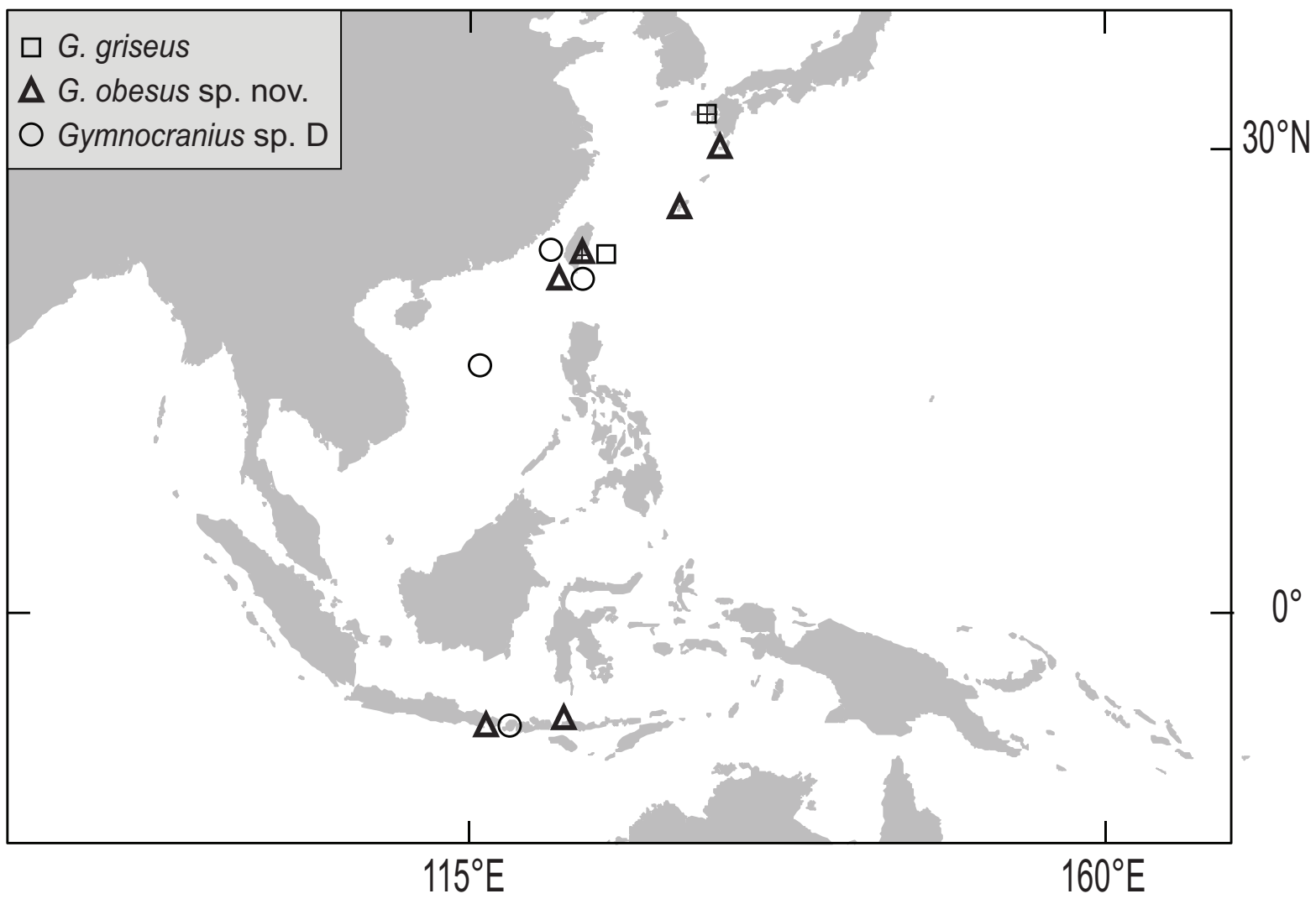


Figure 3



Supplementary material to:

***Gymnocranius obesus*, a new large-eye seabream from the Coral Triangle**

Wei-Jen Chen ^a, Ryohei Miki ^b, Philippe Borsa ^c

^a wjchen.actinops@gmail.com

^b ad13007@student.miyazaki-u.ac.jp

^c philippe.borsa@ird.fr

Supplementary Table S1. *Gymnocranius obesus* sp. nov. Measurements (following [1]) on voucher specimens other than type material, including NMMBP-21546 from Hengchun town, 19 August 2011; NTUM 10741 comprising two specimens from Hengchun town, 10 March 2015; NTUM 10827 from Hengchun town, 10 March 2015. Initial sample number assigned to an individual is given in brackets. *NMMB* National Museum of Marine Biology and Aquarium, Pingtung; *NTUM* National Taiwan University Museums, Taipei; *AF* anal fin; *BD* largest body depth; *CF* caudal fin; *DF* dorsal fin; *SL* standard length

| Measurement | Specimen no. | | | | |
|--|-------------------------|------------------------|------------------------|-------------------------|---------------|
| | NMMBP-21546 (Let426) | NTUM 10741 (Let891) | NTUM 10741 (Let892) | NTUM 10827 (Let1192) | - (Let890) |
| SL (mm) | 183 | 208 | 190 | 232 | 173 |
| Body depth (BD) (mm) | 82 | 96 | 85 | 98 | 78 |
| BD at origin of DF (BDd) (mm) | - | 95 | 84 | 96 | 77 |
| BD at origin of AF (mm) | - | 88 | 78 | 90 | 72 |
| Head length (HL) (mm) | 58.0 | 66.4 | 63.5 | 78.0 | 57.3 |
| Snout length (mm) | 23.6 | 23 | 22.2 | 29.5 | 20 |
| Eye diameter (ED) (mm) | 21.6 | 23.3 | 25.2 | 29.2 | 21.7 |
| Inter-orbital width (IOW) (mm) | 22.0 | 22.0 | 22.7 | 27.0 | 19.2 |
| Predorsal length (mm) | - | 77 | 75 | 94 | 65 |
| Prepelvic length (mm) | - | 72 | 68 | 83 | 56 |
| Preanal length (mm) | - | 127 | 119 | 140 | 104 |
| Median ray of caudal fin(MRC) length (mm) | - | 22.6 | 22.7 | 26.5 | 19.9 |
| DF spines, rays | X, 10 | X, 10 | X, 10 | X, 10 | X, 10 |
| AF spines, rays | III, 10 | III, 10 | III, 10 | III, 10 | III, 10 |
| Pored scales on lateral line | 47 | 47 | 47 | 48 | 48 |
| Ratio of SL to BD | 2.23 | 2.16 | 2.25 | 2.38 | 2.23 |
| Ratio of SL to BDd | - | 2.20 | 2.28 | 2.42 | 2.25 |
| Ratio of SL to HL | 3.16 | 3.13 | 2.99 | 2.97 | 3.02 |
| Ratio of ED to SL | 0.12 | 0.11 | 0.13 | 0.13 | 0.13 |
| Ratio of ED to HL | 0.37 | 0.35 | 0.40 | 0.37 | 0.38 |
| Ratio of ED to IOW | 0.98 | 1.06 | 1.11 | 1.08 | 1.13 |
| Ratio of ED to MRC | NA | 1.03 | 1.11 | 1.10 | 1.09 |

Supplementary Table S2. Measurements on voucher specimens of *G. griseus*. NTUM National Taiwan University Museums, Taipei; *AF* anal fin; *BD* largest body depth; *CF* caudal fin; *DF* dorsal fin; *SL* standard length; *AF* anal fin; *DF* dorsal fin

| Measurement | Voucher no. | | | | | | | |
|--|-------------|-----------|-----------|-----------|-----------|-----------|------------|------------|
| | NTUM 10768 | | | | | | NTUM 10722 | NTUM 10808 |
| | (Let1000) | (Let1001) | (Let1007) | (Let1008) | (Let1009) | (Let1010) | (Let734) | (Let1168) |
| SL (mm) | 208 | 197 | 245 | 260 | 290 | 325 | 298 | 325 |
| Body depth (BD) (mm) | 96 | 95 | 111 | 115 | 126 | 143 | 126 | 138 |
| BD at origin of DF (BDd) (mm) | 95 | 93 | 108 | 112 | 125 | 141 | 123 | 137 |
| BD at origin of AF (mm) | 85 | 85 | 102.2 | 104.3 | 123.6 | 132 | 121 | 128 |
| Head length (HL) (mm) | 65.5 | 60.0 | 74.5 | 80.0 | 86.7 | 95.0 | 87.3 | 94.0 |
| Snout length (mm) | 20.8 | 21.3 | 28.4 | 29.4 | 29.2 | 35.6 | 34.7 | 36.3 |
| Eye diameter (ED) (mm) | 23 | 22.5 | 27 | 27 | 27.5 | 28.2 | 28.2 | 30 |
| Inter-orbital width (IOW) (mm) | 25 | 22.5 | 29.3 | 31.5 | 33 | 35.2 | 33 | 36 |
| Predorsal length (mm) | 70 | 70 | 86 | 86 | 100 | 113 | 101 | 108 |
| Prepelvic length (mm) | 67 | 67 | 77 | 85 | 94 | 103 | 95 | 105 |
| Preanal length (mm) | 131 | 124 | 150 | 160 | 180 | 200 | 175 | 195 |
| Median ray of caudal fin (MRC) length (mm) | na | 24.8 | 28.0 | 29.7 | 33.0 | 36.3 | 33.3 | 26.2 |
| DF spines, rays | X, 10 | X, 10 | X, 10 | X, 10 | X, 10 | X, 10 | X, 11 | X, 10 |
| AF spines, rays | III, 10 | III, 10 | III, 10 | III, 10 | III, 10 | III, 10 | III, 11 | III, 10 |
| Pored scales on lateral line | 47 | 47 | 47 | 48 | 47 | 46 | 48 | 48 |
| Ratio of SL to BD | 2.17 | 2.07 | 2.21 | 2.26 | 2.30 | 2.28 | 2.37 | 2.36 |
| Ratio of SL to BDd | 2.18 | 2.12 | 2.27 | 2.32 | 2.32 | 2.31 | 2.42 | 2.37 |
| Ratio of SL to HL | 3.18 | 3.28 | 3.29 | 3.25 | 3.34 | 3.42 | 3.41 | 3.46 |
| Ratio of ED to SL | 0.11 | 0.11 | 0.11 | 0.10 | 0.09 | 0.09 | 0.09 | 0.09 |
| Ratio of ED to HL | 0.35 | 0.38 | 0.36 | 0.34 | 0.32 | 0.30 | 0.32 | 0.32 |
| Ratio of ED to IOW | 0.92 | 1.00 | 0.92 | 0.86 | 0.83 | 0.80 | 0.85 | 0.83 |
| Ratio of ED to MRC | NA | 0.91 | 0.96 | 0.91 | 0.83 | 0.78 | 0.85 | 1.15 |

Supplementary Table S3. Measurements on voucher specimens of *Gymnocranius* sp.D. NTUM National Taiwan University Museums, Taipei; *AF* anal fin; *BD* largest body depth; *CF* caudal fin; *DF* dorsal fin; *SL* standard length; *AF* anal fin; *DF* dorsal fin

| Measurement | Specimen no. | | | | |
|--|-------------------------|-------------------------|-------------------------|-----------------------------------|---------|
| | NTUM 10818 (Let1211) | NTUM 10826 (Let1191) | NTUM 10831 (Let1341) | NTUM 10835 (Let1362) (Let1363) | |
| SL (mm) | 191 | 176 | 205 | 224 | 149 |
| Body depth (BD) (mm) | 87 | 73 | 81 | 97 | 65 |
| BD at origin of DF (BDd) (mm) | 86 | 71 | 80 | 95 | 63 |
| BD at origin of AF (mm) | 80 | 68 | 73 | 92 | 60 |
| Head length (HL) (mm) | 57.8 | 57.0 | 67.0 | 71.0 | 47.8 |
| Snout length (mm) | 18 | 16.6 | 21.4 | 23.6 | 15.6 |
| Eye diameter (ED) (mm) | 21.5 | 20.5 | 27.0 | 23.8 | 17.4 |
| Inter-orbital width (IOW) (mm) | 24.8 | 20.3 | 28 | 28.5 | 19.4 |
| Predorsal length (mm) | 67 | 59 | 80 | 83 | 53 |
| Prepelvic length (mm) | 63 | 59 | 74 | 76 | 50 |
| Preanal length (mm) | 118 | 118 | 126 | 135 | 86 |
| Median ray of caudal fin (MRC) length (mm) | 23.0 | 18.3 | 26.0 | 24.5 | 18.0 |
| DF spines, rays | X, 10 | X, 10 | X, 10 | X, 10 | X, 10 |
| AF spines, rays | III, 10 | III, 10 | III, 10 | III, 10 | III, 10 |
| Pored scales on lateral line | 49 | 50 | 49 | 49 | 48 |
| Ratio of SL to BD | 2.21 | 2.42 | 2.53 | 2.31 | 2.29 |
| Ratio of SL to BDd | 2.22 | 2.49 | 2.56 | 2.36 | 2.37 |
| Ratio of SL to HL | 3.30 | 3.09 | 3.06 | 3.15 | 3.12 |
| Ratio of ED to SL | 0.11 | 0.12 | 0.13 | 0.11 | 0.12 |
| Ratio of ED to HL | 0.37 | 0.36 | 0.40 | 0.34 | 0.36 |
| Ratio of ED to IOW | 0.87 | 1.01 | 0.96 | 0.84 | 0.90 |
| Ratio of ED to MRC | 0.93 | 1.12 | 1.04 | 0.97 | 0.97 |



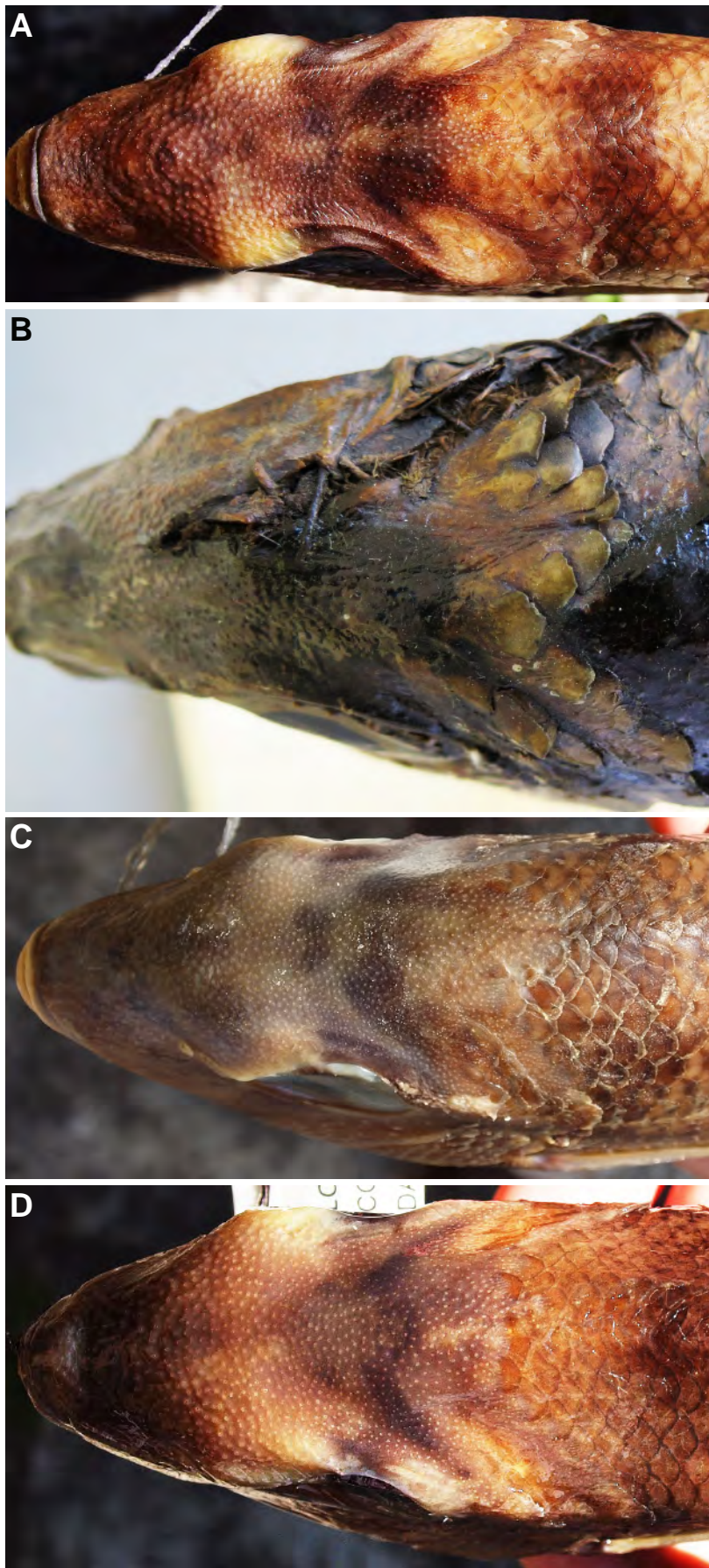
Supplementary Fig. S1. *Gymnocranius obesus* sp. nov. specimens from Indonesia. **A.** Specimen no. 20070222-G2, Kedonganan fish market, Bali, 22 Feb. 2007 (photographed by F. Giancarlo). **B.** Specimen no. 20070223-G5, Kedonganan fish market, Bali, 23 Feb. 2007 (photographed by F. Giancarlo). **C.** Specimen no. 20150503-5, Labuan Bajo fish market, Flores Sea, 03 May 2015 (photographed by S. Bari).



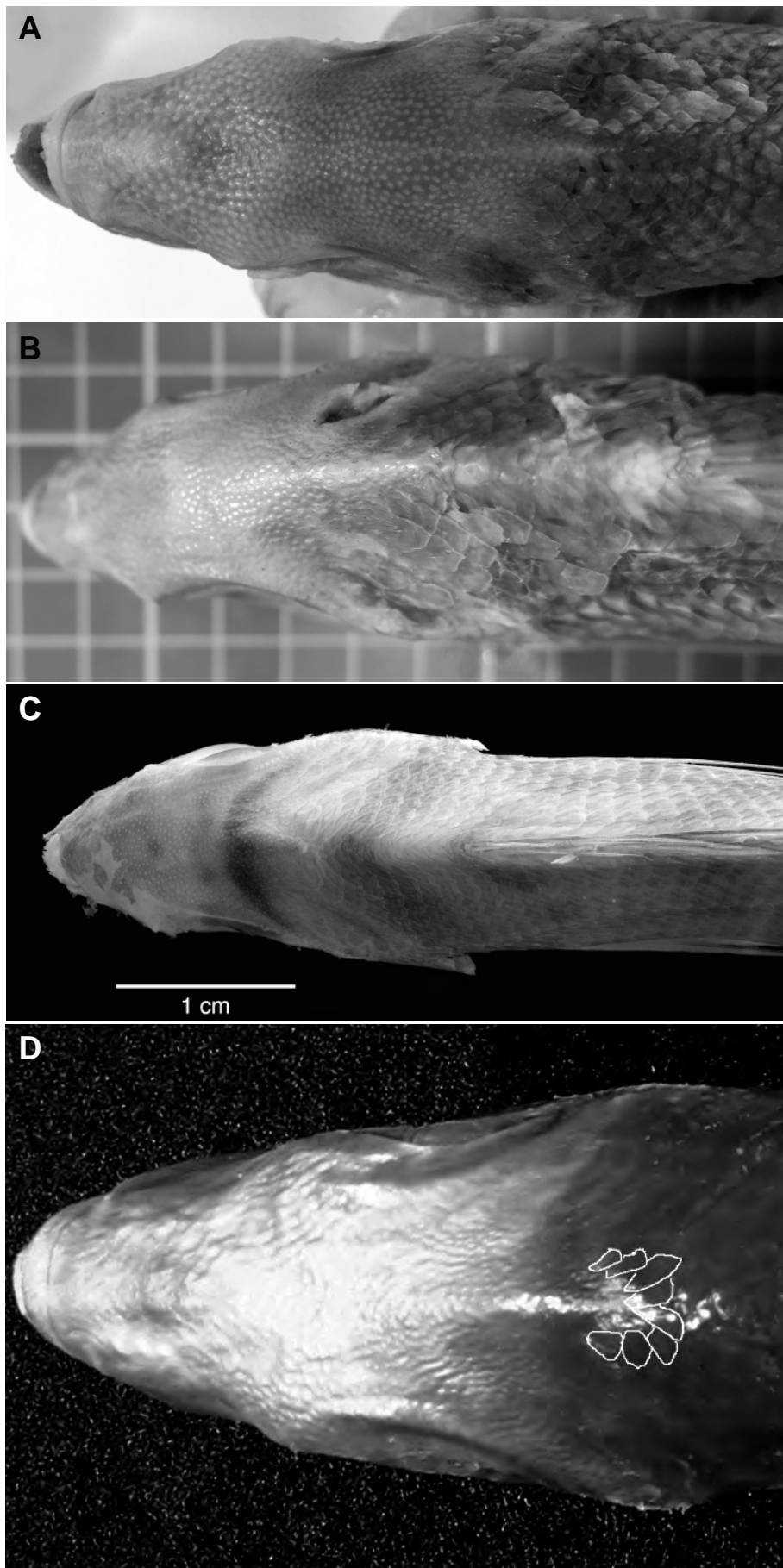
Supplementary Fig. S2. *Gymnocranius griseus* (Temminck and Schlegel 1843). **A.** Specimen no. RMNH.PISC.D.2248, lectotype of the species, SL 343 mm, collected by H. Burger in the Nagasaki region, Japan, ca. 1830 (photographed by Naturalis, Leiden). **B.** Specimen NTUM10722 (= Let734), SL 298 mm, from Chenggong fishing port, Taiwan, 10 September 2012 (photographed by WJC). **C-G.** Respectively, specimens NTUM10768-Let1000 (SL 208 mm), NTUM10768-Let1001 (SL 197 mm), NTUM 10768-Let1007 (SL 245 mm), NTUM 10768-Let1009 (SL 290 mm), and NTUM10768-Let1010 (SL 325 mm) from Fugang fishing port, Taiwan, 03 October 2013 (photographed by WJC). **H.** Specimen NTUM10808 (= Let1168), SL 325 mm, from Fugang fishing port, Taiwan, 09 January 2015 (photographed by WJC).



Supplementary Fig. S3. *Gymnocranius* sp. D. **A.** Specimen no. 20070222-G1, SL 248 mm, Kedonganan fish market, Bali, 22 Feb. 2007 (photographed by F. Giancarlo). **B.** Specimen no. Let427, SL 148 mm, from Hengchun, Taiwan, 19 August 2008 (photographed by H.-C. Ho). **C.** Specimen no. NTUM 10826 (= Let1191), SL 176 mm, from Hengchun, Taiwan, 10 March 2015 (photographed by WJC). **D.** Specimen no. NTUM 10818 (= Let1211), SL 191 mm, from Penghu, Taiwan, 04 May 2015 (photographed by WJC).



Supplementary Fig. S4. Zoom-in on the dorsal side of head, to enable the count of front scales. **A.** *Gymnocranius obesus* sp. nov., specimen no. NTUM 10741-Let892 from Hengchun Town, Taiwan, 10 March 2015 (photographed by WJC). **B.** *Gymnocranius griseus*, lectotype, no. RMNH.N.PISC.D.2248 (photographed by RM). **C.** *Gymnocranius griseus*, specimen no. NTUM 10768-Let1007 from Fugang fishing port, Taiwan, 03 October 2013 (photographed by WJC). **D.** *Gymnocranius* sp. D, specimen no. NTUM 10818 (Let1211) from Penghu, Taiwan, 04 May 2015 (photographed by WJC).



Supplementary Fig. S5. Dorsal side of head in type specimens of several species under *Gymnocranius*. **A.** *Pentapus curtus* Guichenot 1863, specimen no. MNHN 0000-1317 (holotype, photographed by RM). **B.** *Dentex lethrinoides* Bleeker 1850, specimen no. RMNH 5680 (holotype, photographed by RM). **C.** *Gymnocranius orbis* Fowler 1938, specimen no. ANSP 68291 (holotype, photographed by M.S. Perez). **D.** *Dentex robinsoni*, specimen no. SAM 10037 (holotype, photograph provided by M. Bougaardt and A. Bosman).